

A Novel Ultra-compact Star Scanner

Completed Technology Project (2016 - 2017)



Project Introduction

This research is an innovative approach to fuse the rapid advancements in miniaturized high-speed electronics with the ultra-compact freeform optical design from our FY16 efforts to create the next generation of stellar scanner instruments.

The objective of this project is to develop a novel star scanner sensor prototype for integrated Cubesat structures that desire streamlined Guidance, Navigation and Control (GN&C) components. This prototype will be the first star scanner developed to slide into a frame and can be easily swapped with other components. This modularity would *significantly* reduce CubeSat development time, cost, and integration.

The four primary objectives are to develop new freeform optical alignment methods for the mechanical structure. Next, utilize/manufacture a sensor electronics board with a slim volume and develop mature signal processing algorithms specifically for attitude determination software. Last, perform a trade study on emerging detector technology, that promises ~20% (or greater) noise reduction for Goddard Cubesat sensor and instruments.

Anticipated Benefits

A spin stabilized Cubesat platform based on Goddard Spaceflight Center (GSFC) current cubesat designs can benefit from this Ultra-compact technology investment. In the current space limited design for current GSFC CubeSats, there is more than enough volume for slim sensor to enhance the Guidance Navigation and Control (GN&C) knowledge. The combination of this radical optical design and front-end optical design research can revolutionize the way instruments/sensors in science and engineering are applied to GSFC long-term science goals.



3D Printed and Polished
Freeform Lens for Star Scanner

Table of Contents

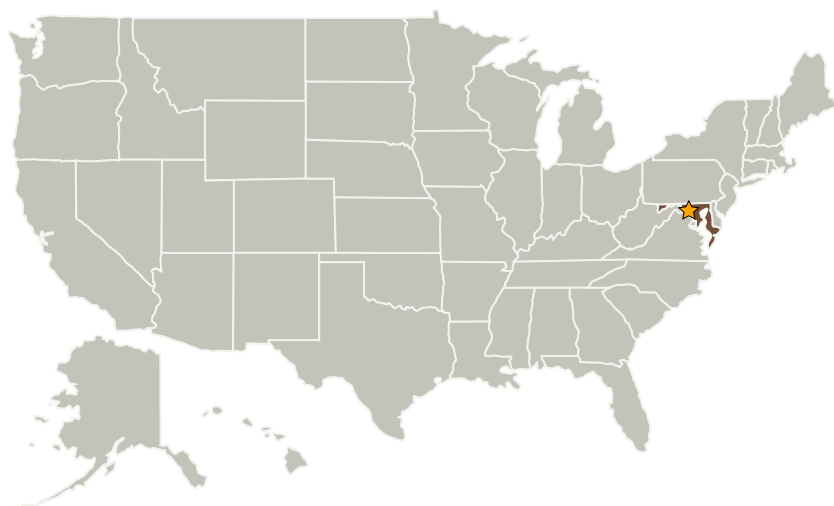
Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	2
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Images	3
Technology Maturity (TRL)	3
Technology Areas	3
Target Destinations	3
Project Website:	4

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations

Maryland

Project Transitions

▶ **October 2016:** Project Start

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Managers:

Jason W Mitchell
Daniel A Mullinix
Michael A Johnson

Principal Investigator:

Sean R Semper

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✓ **September 2017:** Closed out

Closeout Summary: The purpose of the Goddard Space Flight Center's Internal Research and Development (IRAD) program is to support new technology development and to address scientific challenges. Each year, Principal Investigators (PIs) submit IRAD proposals and compete for funding for their development projects. Goddard's IRAD program supports eight Lines of Business: Astrophysics; Communications and Navigation; Cross-Cutting Technology and Capabilities; Earth Science; Heliophysics; Planetary Science; Science Small Satellites Technology; and Suborbital Platforms and Range Services. Task progress is evaluated twice a year at the Mid-term IRAD review and the end of the year. When the funding period has ended, the PIs compete again for IRAD funding or seek new sources of development and research funding or agree to external partnerships and collaborations. In some cases, when the development work has reached the appropriate Technology Readiness Level (TRL) level, the product is integrated into an actual NASA mission or used to support other government agencies. The technology may also be licensed out to the industry. The completion of a project does not necessarily indicate that the development work has stopped. The work could potentially continue in the future as a follow-on IRAD; or used in collaboration or partnership with Academia, Industry and other Government Agencies. If you are interested in partnering with NASA, see the TechPort Partnerships documentation available on the TechPort Help tab. <http://techport.nasa.gov/help>

Images

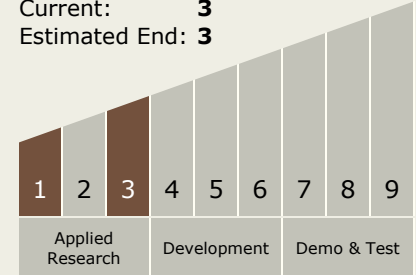


Freeform Lens

3D Printed and Polished Freeform Lens for Star Scanner
(<https://techport.nasa.gov/image/27936>)

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
 - └ TX17.2 Navigation Technologies
 - └ TX17.2.1 Onboard Navigation Algorithms

Other/Cross-cutting:

- TX17 Guidance, Navigation, and Control (GN&C)
 - └ TX17.2 Navigation Technologies
 - └ TX17.2.3 Navigation Sensors

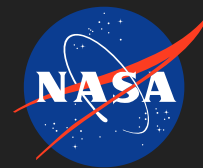
Target Destinations

Earth, Outside the Solar System, Foundational Knowledge

Center Independent Research & Development: GSFC IRAD

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Project Website:

<http://aetd.gsfc.nasa.gov/>